
WBS 4.1 Silicon Upgrades

October 2001

Overview

- **Pixels**
 - Upgrade from 2-hit system to 3-hit system
 - Upgrade R&D related to at least B-layer(innermost) layer replacement after few years operation. Possibly entire new system.
- **Silicon Strips(SCT)**
 - Upgrade R&D related to 0.25(or 0.18) micron spares for integrated circuits and future replacement
 - Major upgrade to replace SCT and possibly replace TRT
- **ReadOut Drivers(RODs)**
 - RODs for 3rd pixel hit
 - Upgrade R&D mostly related to pixel ROD replacement ie. new B-layer
 - New RODs for new pixels eg. B-layer
 - New RODs for SCT major upgrade

Pixels

- Add 3rd hit
 - Essential for pattern recognition beyond first(lower luminosity) operation
 - Profile assumes must be ready in 2007.
 - Does not assume continuation of procurements and assembly lines - a possible problem.
- Upgrade R&D
 - Since pixels are new technology, it's inevitable there will be need for relatively rapid R&D
 - IC electronics eg. going from 0.25 micron to 0.18(or smaller) micron technology to keep pace with industry and to add functionality
 - Reduce material in mechanical/thermal/services structure and increase reliability
 - R&D will take some years, 3 in our model.
- Replacement
 - At least B-layer, maybe more. We assume about a 3 year fabrication duration after R&D + installation.

Pixel Profile(4.1.1)

Upgrades to U.S. ATLAS WBS Profile Estimates

Funding Source: All

Funding Type: Project

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Institutions: All

WBS Number	Description	FY 03 (k\$)	FY 04 (k\$)	FY 05 (k\$)	FY 06 (k\$)	FY 07 (k\$)	FY 08 (k\$)	FY 09 (k\$)	FY 10 (k\$)	FY 11 (k\$)	FY 12 (k\$)	Total (k\$)
4.1.1	Pixels	0	790	1676	2068	1532	1968	1444	366	0	0	9843
4.1.1.1	Upgrade R&D	0	517	676	1331	0	0	0	0	0	0	2524
4.1.1.1.1	Mechanics/Services	0	78	103	103	0	0	0	0	0	0	285
4.1.1.1.2	Sensors	0	74	69	114	0	0	0	0	0	0	257
4.1.1.1.3	Electronics	0	340	349	667	0	0	0	0	0	0	1356
4.1.1.1.4	Hybrids	0	0	86	203	0	0	0	0	0	0	289
4.1.1.1.5	Module assembly	0	26	57	220	0	0	0	0	0	0	303
4.1.1.1.6	Test beam support	0	0	11	23	0	0	0	0	0	0	34
4.1.1.2	Third hit upgrade	0	272	1000	736	241	0	0	0	0	0	2250
4.1.1.2.1	Mechanics	0	0	347	254	182	0	0	0	0	0	782
4.1.1.2.2	Sensors	0	164	0	0	0	0	0	0	0	0	164
4.1.1.2.3	Electronics	0	0	208	58	0	0	0	0	0	0	266
4.1.1.2.4	Flex Hybrids/Optical Hybrids	0	0	315	254	0	0	0	0	0	0	569
4.1.1.2.5	Module assembly/Test	0	108	131	170	60	0	0	0	0	0	469
4.1.1.3	B-layer replacement	0	0	0	0	1291	1968	1444	366	0	0	5069
4.1.1.3.1	Mechanics/Services	0	0	0	0	339	501	630	366	0	0	1836
4.1.1.3.2	Sensors	0	0	0	0	104	204	0	0	0	0	308
4.1.1.3.3	Electronics	0	0	0	0	512	596	304	0	0	0	1412
4.1.1.3.4	Hybrids	0	0	0	0	192	283	186	0	0	0	661
4.1.1.3.5	Modules	0	0	0	0	143	384	324	0	0	0	851

Silicon Strips(SCT)

- Spare R&D
 - We have included purchase of DMILL ICs as spares in our M&O estimate.
 - However, it is clear that there should also be R&D leading to the development of a complete SCT chip in 0.25(or smaller) micron technology. We have included US participation in this R&D.
 - There is no consensus yet within ATLAS on the best approach in this area.
- Major upgrade/replacement
 - We have included R&D directed at either replacement of the SCT or the TRT or both.
 - And a first guess at major upgrade costs.

SCT Profile(4.1.2)

Upgrades to U.S. ATLAS WBS Profile Estimates

Funding Source: All

Funding Type: Project

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Institutions: All

WBS Number	Description	FY 03 (k\$)	FY 04 (k\$)	FY 05 (k\$)	FY 06 (k\$)	FY 07 (k\$)	FY 08 (k\$)	FY 09 (k\$)	FY 10 (k\$)	FY 11 (k\$)	FY 12 (k\$)	Total (k\$)
4.1.2	SCT	0	188	188	188	165	387	387	1000	4000	6000	12502
4.1.2.1	Upgrade R&D	0	188	188	188	165	387	387	0	0	0	1502
4.1.2.1.1	Spare R&D	0	188	188	188	55	0	0	0	0	0	619
4.1.2.1.2	Replacement R&D	0	0	0	0	110	387	387	0	0	0	883
4.1.2.2	Upgrades	0	0	0	0	0	0	0	1000	4000	6000	11000

ReadOut Drivers(RODs)

- These are linked to the pixel and SCT upgrades
- Need RODs for 3rd pixel hit.
- Need RODs for pixel replacement
- Need RODs for SCT replacement
- Have included some R&D leading to replacement

RODs(4.1.3)

Upgrades to U.S. ATLAS WBS Profile Estimates

Funding Source: All

Funding Type: Project

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Institutions: All

WBS Number	Description	FY 03 (k\$)	FY 04 (k\$)	FY 05 (k\$)	FY 06 (k\$)	FY 07 (k\$)	FY 08 (k\$)	FY 09 (k\$)	FY 10 (k\$)	FY 11 (k\$)	FY 12 (k\$)	Total (k\$)
4.1.3	ReadOut Drivers	0	0	0	507	283	353	574	172	353	353	2597
4.1.3.1	Upgrade R&D	0	0	0	210	283	0	0	0	0	0	493
4.1.3.2	Upgrade - pixel RODs	0	0	0	297	0	353	574	0	0	0	1224
4.1.3.3	Upgrade - SCT RODs	0	0	0	0	0	0	0	172	353	353	879

Summary Profile

Upgrades to U.S. ATLAS WBS Profile Estimates

Funding Source: All

Funding Type: Project

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Institutions: All

WBS Number	Description	FY 03 (k\$)	FY 04 (k\$)	FY 05 (k\$)	FY 06 (k\$)	FY 07 (k\$)	FY 08 (k\$)	FY 09 (k\$)	FY 10 (k\$)	FY 11 (k\$)	FY 12 (k\$)	Total (k\$)
4.1	Silicon	0	978	1864	2762	1980	2708	2405	1538	4353	6353	24942
4.1.1	Pixels	0	790	1676	2068	1532	1968	1444	366	0	0	9843
4.1.1.1	Upgrade R&D	0	517	676	1331	0	0	0	0	0	0	2524
4.1.1.2	Third hit upgrade	0	272	1000	736	241	0	0	0	0	0	2250
4.1.1.3	B-layer replacement	0	0	0	0	1291	1968	1444	366	0	0	5069
4.1.2	SCT	0	188	188	188	165	387	387	1000	4000	6000	12502
4.1.2.1	Upgrade R&D	0	188	188	188	165	387	387	0	0	0	1502
4.1.2.2	Upgrades	0	0	0	0	0	0	0	1000	4000	6000	11000
4.1.3	ReadOut Drivers	0	0	0	507	283	353	574	172	353	353	2597
4.1.3.1	Upgrade R&D	0	0	0	210	283	0	0	0	0	0	493
4.1.3.2	Upgrade - pixel RODs	0	0	0	297	0	353	574	0	0	0	1224
4.1.3.3	Upgrade - SCT RODs	0	0	0	0	0	0	0	172	353	353	879

Conclusions

- Silicon system upgrades should be integral part of U.S. ATLAS plan. Other than trigger/DAQ, this is the subsystem within ATLAS that has the greatest upgrade potential and need.
- Most immediate issues are the 3rd pixel hit and participation in deep-submicron R&D for SCT readout.
- Personnel for these upgrades are straightforward to identify and follow naturally from our current plans.
- Upgrade R&D for pixels, to continue to advance the state of the art, is also essential to ATLAS.